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A REVIEW PAPER ON LEAN AND OCCUPATIONAL HEALTH AND SAFETY (OHS) IN RMG INDUSTRY

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Abstract- *Reduction of production lead time, frequent changeover of styles and intensive manual operations are main characteristics of Apparel industry. For shortening the response time to changes, the apparel industry is tending to switch to Lean practicing mode. For the last few years, apparel industry along with other manufacturing industries are trying to have beneficiaries by implementing Lean tools. As Lean manufacturing technique and work environment are connected factors, there should have synergies between Lean production and Occupational Health and Safety with an exploration of Lean and its implications for the working environment. But debate arouses about the synergies between these two factors. This article is the review of this controversy. The methodology is to go through searching of the relevant database for finding qualitative, quantitative and mixed methods articles, relating to Lean production system and OHS in Ready Made Garments Industry (RMG). Required information about Lean and effects on OHS has been extracted by analyzing 25 literature review regarding Lean manufacturing technique and OHS, among them most of the reviews are based on either Lean production or OHS. Very few were regarding on implication of both. This review paper showed a research gap in the implication of combined effect of Lean and OHS in RMG sector, which promotes further research on this arena.*

Keywords: Apparel Industry, Lean, OHS, Synergies, Literature review

1. INTRODUCTION

Lean is a widely discussed term in RMG industries where the philosophy is aimed to improve the productivity. As a labor-intensive assembly industry, RMG has a vast scope of adopting lean tools to benefit the production workers regarding working condition and productivity. RMG industry is also infamous for exploiting occupational health and safety issues [1]. Lean is a philosophy based on "The Toyota Production System" or TPS which has originated to a large scale with Japanese production system [2]–[4] and the main objective of lean is to eliminate waste at the same time by reducing or optimizing supplier, customer, and internal variability" [5]. It benefits the employees working in production as this promotes a higher degree of participation from them and continuous elimination of waste of non-value added process during production [6]. These two authors analyzed the theoretical definition with a survey of lean practices applied in manufacturing industry by sorting out ten key methods: supplier feedback, JIT delivery, developing suppliers, involved customers, pull, flow, set-up time, controlled processes, TPM, and involved employees. However, lean also has some controversial consequences when it had its first application in manufacturing processes in automotive industry. Lean directly focuses on the changes in working place, so its expectation on the working condition of employees is vital and already made into a debate for discussion. It was pointed out that lean would increase the intensity of work, intensify the control of management, and have a negative impact on employee's health condition [7].

Poor OHS and working conditions are the prime concerns of RMG industries along with the low productivity issues. Research has been done from different perspectives on the productivity and OHS issues of RMG industries separately, but literature are very limited regarding considering the productivity and OHS issue as a whole. Past research outcomes show, if we want to implement the tools of lean technique such as value stream map, 5S, JIT process etc. by reducing waste and unnecessary movement these might improve the productivity, but at the same time they might have a negative effect on OHS practice which may trigger the compliance issue. On the other hand, businessmen are not willing to implement lean practices due to lack of knowledge and competence for both lean implementation and OHS. There is a debate in discussion still now whether implementation of lean has adverse effect on occupational health and safety (OHS) especially related to ready-made garment factories. So, it is clear that there is an unexploited connection between lean tools and OHS which must be studied. This paper aims to have an overall idea about lean and occupational

health and safety in RMG industries and their combined effect on the production process.

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2. BACKGROUND

RMG is one of the most labor-intensive industries in the world. As a result, RMG industries are only found in countries where labor is available in abundance. China is the biggest supplier of RMG to the world followed by other Asian countries like Bangladesh, India, Sri-Lanka Vietnam and Indonesia. All of these countries have cheap labor availability and their infrastructures & economies are growing. A common problem of most of the RMG industries is unskilled workers, in-efficient mid-level management, low productivity and poor working conditions. Many industries are in a mad race of production keeping aside OHS issues and ethical business. As a result, the working conditions in the RMG industries has become an extreme concern.

Studies reveal industries in different countries are trying to resolve this problem in different ways. Sri Lanka is adopting lean manufacturing to meet global business challenges. However, they are yet to develop an appropriate performance measuring system for a lean environment in the apparel industries [8]. In India most of the lean initiated apparel industries are in the planning, learning, commencing and improving stage and has a long way to go towards complete transformation [9]. A study in Botswana revealed a high prevalence of musculoskeletal disorders [10]. Another research in Jordan revealed that adoption of the lean supply practices is considerably high in all aspects, except for supplier development [11]. All these experiences in different countries are to improve productivity and reduce OHS difficulties like ergonomics and musculoskeletal disorders. Hence, a study on garments industries regarding productivity improvement keeping the OHS conditions in mind is needed. But there are very few studies conducted in the industry to resolve the problem. Hence, a comprehensive research on the industries is essential to achieve a more thorough understanding of the OHS issues and its interaction with productivity and the possibilities to improve the both simultaneously.

3. METHODOLOGY

We chose systematic search and review process [16] and followed a standard procedure of literature search, data extraction, and synthesis. The research team was composed of researchers based in Bangladesh and Denmark. At the start of the study, the researchers decided on about search terms, definitions, and the research questions.

The literature search included qualitative, quantitative and mixed methods articles that focused on synergies between Lean and Occupational Health and Safety in RMG industries.

The research team guided the searching of keywords and the keywords were Ready made garment or Apparel, Lean and Occupational Health and Safety and their synonyms.

Business Source Premier, Scopus, and Web of Science were used to search literature. Among the articles that we have searched by using those search engines, a maximum number of articles were based on other fields like medical science, automotive industries, agriculture sector etc. We have only picked the papers based on only garments sector. We excluded the papers which were based on textile machinery, garments product design, chemical barrier, Ergonomic clothing comfort, garments trade regulation, and cloths classification. We have also refined the list considering publication date, document and source type and subject area. After reading the title and abstract, the number of papers stood 64 though, among them, most of the papers did not include occupational health and safety.

Researchers reviewed titles and abstracts of the articles to establish whether the study met inclusion criteria. By using Google scholar and having access to Online Library of the University, we were able to assess the rest of the articles. When there was insufficient information in a paper, full texts of the review paper were retrieved and assessed and removed the papers which were unnecessary, duplicated and as well as which couldn't be accessed. So the final number of paper becomes 25.

4. RESULTS AND DISCUSSION

Different studies show the effect of lean tools application on the productivity of various industries. In some studies, there is evidence of improvement of productivity. Again some studies also show a negative effect in some cases, especially on the OHS and compliance issues. This paper discusses the different outcomes of different kinds of literature written on the positive and negative effects of lean tools on productivity and OHS from the 25 research papers selected through a systematic search described in the methodology. The summary of the papers are accumulated in table 1.

4.1 Lean Principle

Many kinds of literature used lean as a principle instead of mentioning the effect of any specific lean tools. Industries adopted lean in different ways according to their needs to improve productivity. For example, one researcher developed a model for performance measurement for lean implementing industries in the apparel sector [8]. So according to this researcher, introducing KPAs would enhance the operation excellence. Another study developed a waste identification diagram (WID) to identify potential wastes that can be eliminated from the production process [34]. According to another researcher, a lean implementation methodology was developed in the textile and garments industry to create an ergonomic and sustainable working environment [24]. So, we can conclude that, among those papers, only one paper has positive thinking about both Productivity and OHS. And rest of the papers described only positive thinking of Productivity.

4.2 Value Stream Mapping (VSM)

VSM is considered as the base or initial tool to examine the current state of production and scopes of improvement [37]. Different literature reveals the application of VSM in RMG industries in different countries. For example, VSM was applied in an Indian

RMG industry to identify critical nonvalue added activities and remove them from production floor [21]. Again it was also applied in a Sri Lankan apparel industry to successfully reduce wastes such as transport, inventory and defects and improve productivity [22]. VSM is also very helpful to reduce the lead time, production costs and time and cost to rearrange a layout [38].

According to the findings from the above literature, a positive impact on productivity is confirmed by applying VSM, especially in RMG industry. However, maximum literature didn't consider the OHS issues in RMG regarding VSM, but in one article, an author mentioned about the poor condition of the workplace.

Table 1: Summary of the review

Serial No.	Lean Tools	Effect on Productivity	Effect on OHS	Ref. no.
1	JIT	Positive	Nil	[17]
2	TQM	Positive	Positive, Negative	[18]
3	Lean Principle	Positive, Negative	Nil	[19]
4	TPM	Positive	Positive	[20]
5	VSM	Positive	Positive	[21]
6	SMED	Positive	Nil	[21]
7	VSM	Positive	Nil	[22]
8	VSM	Positive	Nil	[23]
9	Lean Principle	Positive	Positive	[24]
10	Lean Principle	Model development	Nil	[8]
11	QRM	Positive	Positive and Negative	[7]
12	VSM	Positive	Nil	[25]
13	Kaizen (DHU, 5S)	Positive	Positive	[26]
14	5S and VSM	Positive	Nil	[27]
15	Lean Principle	Positive and Negative	Nil	[28]
16	GT	Positive	Nil	[29]
17	VSM	Positive	Nil	[30]
18	Job Involvement	Positive	Positive	[31]
19	Lean Principle (TQPP)	Positive and Negative	Nil	[32]
20	JIT	Positive and Negative	Nil	[11]
21	JIT	Positive and Negative	Negative	[33]
22	lean	Positive	Nil	[34]
23	lean production	Positive	Nil	[31]
24	VSM, Kaizen	Positive	Negative	[35]
25	REDUTex	Positive	Nil	[36]

4.3 5S

A case study in India reveals that application of 5S methodology shows significant improvements in safety, productivity, efficiency and housekeeping and helps to make stronger work ethics within the management and workers [39]. Another study in Pakistan in an apparel industry shows that application of 5S brings improvement in compliance and effective workflow due to lesser machine breakdown, lower defect rates, reduced inventory and effective problem visualization [40]. So, according to different studies, it is found that 5S affects both productivity and OHS.

4.4 Just in Time (JIT)

Textile producers at DuPont's May Plant in Camden, South Carolina, utilized JIT principles to improve their manufacturing performance, Product quality and Labor cost.

Another ethnographic research was done in a highend RMG industry in Mexico, where the researchers achieved success by applying JIT. The study reveals that the labor process under lean production proved to be both benefited and hampered as it facilitated the radicalization and mobilization of workers [41].

4.5 Total Productive Maintenance (TPM)

Another lean tool total productive maintenance (TPM) was applied in 30 textile and apparel manufacturing firms to determine the manufacturing performance. The results show that all the TPM practices have a positive and significant relationship with manufacturing performance and significantly improve cost effectiveness, product quality, on-time delivery and volume flexibility. One of the TPM practices; safety and health environment included studies on work environment, eliminate injuries and accidents have the highest impact on volume flexibility along with flexibility maintenance and office TPM [42].

4.6 Single-Minute Exchange of Die (SMED)

SMED (Single-Minute Exchange of Dies) is a system for dramatically reducing the time for complete equipment changeovers. In a study done in an Indian apparel industry where VSM and SMED were applied simultaneously to reduce waste and improve productivity revealed formidable success. VSM helped to identify the wastes and its causes and SMED helped to reduce the setup time [21]. But according to literature, there is no discussion about the impact of this tool on OHS.

4.7 Kaizen

The Kaizen approach promotes improvement in productivity and helps in reduction of defects per hundred units [26]. Again, a positive effect was found in the psychological working environment as there were work-roles with greater breadth, more variation, higher skill utilization and higher cognitive demands among the workers after implementing kaizen tool. [7].

We are unable to find a clear and distinct relationship between Lean and OHS. From the articles we found that

some of them emphasized on Lean only and some of them on OHS only. Very few articles were there, which showed the way of preventing negative effects on the work environment and workers' health by showing involvement of workers both in Lean implementation and in the operation of the lean production system in the practice.

5. CONCLUSION

This article comprised of comprehensive systematic literature review of 25 research articles of the last decade regarding the possible effect of Lean and OHS. The research gap that has been showed on this article is there is no parameter for proper correlation between Lean and OHS. As Lean and working environment are closely connected, so there should be exploration of Lean and its implications for the working environment. No proper decision was made about the synergies between these two factors, which we will be implementing in near future as our research paper is in continuous pattern. In the future articles under this research, we will show the synergies between Lean and OHS, which is the goal of our research. The limitation of this research is we are focusing only on readymade garment industry. The synergies should be implemented in rest of the fields of industry.

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